

REPORT NUMBER: 301-MGA-2009-003

**SAFETY COMPLIANCE TESTING FOR FMVSS 301R
FUEL SYSTEM INTEGRITY – REAR IMPACT**

**MAZDA MOTOR CORPORATION
2009 MAZDA 3
NHTSA NUMBER: C95404**

**PREPARED BY:
MGA RESEARCH CORPORATION
5000 WARREN ROAD
BURLINGTON, WI 53105**



Test Date: April 15, 2009

Final Report Date: April 22, 2009

FINAL REPORT

**PREPARED FOR:
U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
1200 NEW JERSEY AVENUE, S.E., NVS-220
WASHINGTON, D.C. 20590**

This final test report was prepared for the U.S. Department of Transportation, National Highway Traffic Safety Administration, in response to Contract Number DTNH22-06-C-00030.

This publication is distributed by the U.S. Department of Transportation, National Highway Traffic Safety Administration, in the interest of information exchange. The opinions, findings and conclusions expressed in this publication are those of the author(s) and not necessarily those of the Department of Transportation or the National Highway Traffic Safety Administration. The United States Government assumes no liability for its contents or use thereof. If trade or manufacturers' names or products are mentioned it is only because they are considered essential to the object of the publication and should not be construed as an endorsement. The United States Government does not endorse products or manufacturers.

Prepared by: Joe Fleck Date: 4/16/09
Joe Fleck, Project Engineer

Reviewed by: David Winkelbauer Date: 4/16/09
David Winkelbauer, Facility Director

FINAL REPORT ACCEPTED BY:

Edward E. Chan
Digitally signed by Edward E. Chan
DN: CN = Edward E. Chan, C = US, O =
National Highway Traffic Safety Administration,
OU = Office of Vehicle Safety Compliance
Date: 2009.04.22 09:31:38 -04'00'

COTR, Rear Impact

4/22/2009
Date of Acceptance

Technical Report Documentation Page

1. Report No. 301-MGA-2009-003	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Final Report for Fuel System Integrity Test of a 2009 Mazda 3 NHTSA No.: C95404		5. Report Date April 17, 2009	
		6. Performing Organization Code MGA	
7. Author(s) Joe Fleck, Project Engineer		8. Performing Organization Report No. 301-MGA-2009-003	
9. Performing Organization Name and Address MGA Research Corporation 5000 Warren Road Burlington, WI 53105		10. Work Unit No.	
		11. Contract or Grant No. DTNH22-06-C-00030	
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Enforcement, Office of Vehicle Safety Compliance 1200 New Jersey Avenue, S.E., NVS-220 Washington, D.C. 20590		13. Type of Report and Period Covered Final Report 4/15/2009 – 4/22/2009	
		14. Sponsoring Agency Code NVS-220	
15. Supplementary Notes			
16. Abstract A rear impact was conducted on a 2009 Mazda 3 at MGA Research Corporation on April 15, 2009. This test was conducted to obtain data indicant of FMVSS 301R. The impact velocity was 79.1 km/h. The ambient temperature at the time of impact was 10 degrees Celsius.			
17. Key Words Fuel System Integrity Test 2009 Mazda 3 NHTSA No: C95404		18. Distribution Statement Copies of this report are available from: National Highway Traffic Safety Admin., Technical Ref. Division, 1200 New Jersey Avenue, SE Washington, D.C. 20590	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 59	22. Price

TABLE OF CONTENTS

<u>Section</u>		<u>Page No</u>
1	Purpose and Summary of Test	1
2	Data Sheets	2
<u>Data Sheet No.</u>		<u>Page No.</u>
1	Test Vehicle Specifications	2
2	Pre-Test Data	4
3	Moving Barrier Data	6
4	Post-Test Data	7
5	Static Rollover Test Data	8
<u>Form No.</u>		
1	Test Vehicle Information	10
<u>Appendix</u>		
A	Photographs	A

SECTION 1

PURPOSE AND SUMMARY OF TEST

PURPOSE

This rear impact test is sponsored by the National Highway Traffic Safety Administration (NHTSA) under contract number DTNH22-06-C-00030. The purpose of this test is to reduce deaths and injuries occurring from fires that result from fuel spillage during and after motor vehicle crashes and resulting from ingestion of fuels during siphoning.

SUMMARY

A 2009 Mazda 3 was impacted by a Moving Deformable Barrier (MDB) at a velocity of 79.1 km/h. The test was performed at MGA Research Corporation on April 15, 2009. Pre-and post-test photographs of the vehicle and dummies can be found in Appendix A.

One real-time camera and four high-speed cameras were used to document the impact event.

- Left Rear Half 1000 fps
- Right Rear Half 1000 fps
- Overhead Overall 1000 fps
- Right Overall 1000 fps
- Real Time Pan 24 fps

Two ballast Part 572E, 50th percentile male anthropomorphic test devices (ATDs) were placed in the driver and right-front passenger seating positions according to dummy placement instructions specified in the Laboratory Indicant Test Procedure.

There was no Stoddard Solvent leakage after the event or during any phase of the static rollover.

The vehicle appeared to comply with all the requirements of FMVSS No. 301 "Fuel System Integrity."

SECTION 2
DATA SHEETS

DATA SHEET NO. 1
TEST VEHICLE SPECIFICATIONS

Test Vehicle: 2009 Mazda 3 NHTSA No.: C95404
Test Program: FMVSS 301 Fuel System Integrity Test Date: 4/15/2009

TEST VEHICLE INFORMATION

Manufacturer	Mazda Motor Corporation
Model	Mazda 3
Body Style	Sedan
Major Options	Power Moonroof
NHTSA No.	C95404
VIN	JM1BK32F991241522
Color	Copper Red Mica
Delivery Date	3/5/2009
Odometer Reading (mile)	68
Dealer	Bill Marine Mazda
Transmission	Automatic
Final Drive	Front Wheel Drive
Number of Cylinders	4
Engine Displacement (L)	2.0
Engine Placement	Lateral

DATA FROM VEHICLE'S CERTIFICATION LABEL

Manufactured By	Mazda Motor Corporation
Date of Manufacture	10/08

GVWR (kg)	1733
GAWR Front (kg)	938
GAWR Rear (kg)	795

VEHICLE CAPACITY DATA

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Split Bench		
Number of Occupants	2	3		5
Capacity Wt. (VCW) (kg)				385
Number of Occupants x 68 kg.				340
Cargo Wt. (RCLW) (kg)				45

DATA SHEET NO. 1 (continued)
TEST VEHICLE SPECIFICATIONS

Test Vehicle: 2009 Mazda 3 NHTSA No.: C95404
 Test Program: FMVSS 301 Fuel System Integrity Test Date: 4/15/2009

DATA FROM VEHICLE'S TIRE PLACARD

Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	300	300
Cold Pressure (kPa)	220	220
Recommended Tire Size	P205/50R17	P205/50R17
Recommended Load Range	88V	88V
Tire Size on Vehicle	P205/50R17	P205/50R17
Tire Manufacturer	Goodyear	Goodyear
Location of Placard of Vehicle	Left Front Door Jam	
Type of Spare Tire (full size/space saver)	Space Saver	

DATA SHEET NO. 2**PRE-TEST DATA**Test Vehicle: 2009 Mazda 3NHTSA No.: C95404Test Program: FMVSS 301 Fuel System IntegrityTest Date: 4/15/2009**WEIGHT OF TEST VEHICLE**

	Units	As Delivered (UVW) (Axle)			As Tested (ATW) (Axle)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	398.3	254.0		448.6	295.3	
Right	kg	400.5	252.2		466.3	281.2	
Ratio	%	61.2	38.8		61.3	38.7	
Totals	kg	798.8	506.2	1305.0	914.9	576.5	1491.4

CALCULATION OF TARGET TEST WEIGHT (TTW)

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	1305.0
Rated Cargo/Luggage Weight (RCLW)	kg	45
Weight of 2 P572E ATDs	kg	148
Calculated Vehicle Target Weight (TVTW)	kg	1498

Vehicle Wheelbase	2640
Vehicle Width	1745
Weight of Ballast secured in Engine Bay	27.2 kg
Method of Securing Ballast	Air box and Zip ties
Vehicle Components Removed for Weight Reduction	None

VEHICLE ATTITUDES

	Units	LF	RF	LR	RR
As Delivered	mm	675	682	695	693
As Tested	mm	653	660	677	680

DATA SHEET NO. 2 (continued)**PRE-TEST DATA**Test Vehicle: 2009 Mazda 3NHTSA No.: C95404Test Program: FMVSS 301 Fuel System IntegrityTest Date: 4/15/2009**FUEL SYSTEM DATA**

	Units: Liters
Usable Capacity of "Standard Tank" (Owner's Manual)	54.9
Usable Capacity Figure Furnished by COTR	54.9
Usable Capacity of "Optional" Tank	
92-94% of Usable Capacity	50.5 to 51.6
Actual Test Volume (entire fuel system filled)	51.1

Test Fluid Type	Stoddard Solvent
Test Fluid Kinematic Viscosity (centistokes)	2.1 cSt @ 20° C
Test Fluid Color	Purple
Type of Vehicle Fuel Pump	Electrical
Activate Electric Fuel Pump Operation with Ignition Switch ON, but Engine OFF	Yes

Comments (noticeable attributes of fuel system components, capacity, etc.)	None
--	------

DATA SHEET NO. 3
MOVING BARRIER DATA

Test Vehicle: 2009 Mazda 3 NHTSA No.: C95404
 Test Program: FMVSS 301 Fuel System Integrity Test Date: 4/15/2009

MOVING BARRIER'S TEST WEIGHT

	Units	Front	Rear	Total
Left	kg	374.2	308.8	
Right	kg	389.5	291.2	
Ratio	%	56.0	44.0	
Totals	kg	763.7	600.0	1363.7

Tires (Mfr, line, size)	Yokohama
Tire Pressure (kPa)	207
Brake Abort System (Yes/No)?	Yes
Date of Last Calibration	8/6/2008

DATA SHEET NO. 4**POST-TEST DATA**Test Vehicle: 2009 Mazda 3NHTSA No.: C95404Test Program: FMVSS 301 Fuel System IntegrityTest Date: 4/15/2009**IMPACT VELOCITY**

	Units: km/h
Required Impact Velocity	80.0
Actual Impact Velocity (Trap No. 1)	79.1
Actual Impact Velocity (Trap No. 2)	79.1
Average Impact Speed	79.1

Temperature at Time of Impact (°C)	10
Test Time	9:23 am

WELDING ROD IMPACT POINT

	Units: mm
Vertical distance from target center (+ above target / - below target)	3 mm down
Horizontal distance from target center (+ to the right / - to the left)	8 mm to the right

DATA SHEET NO. 5

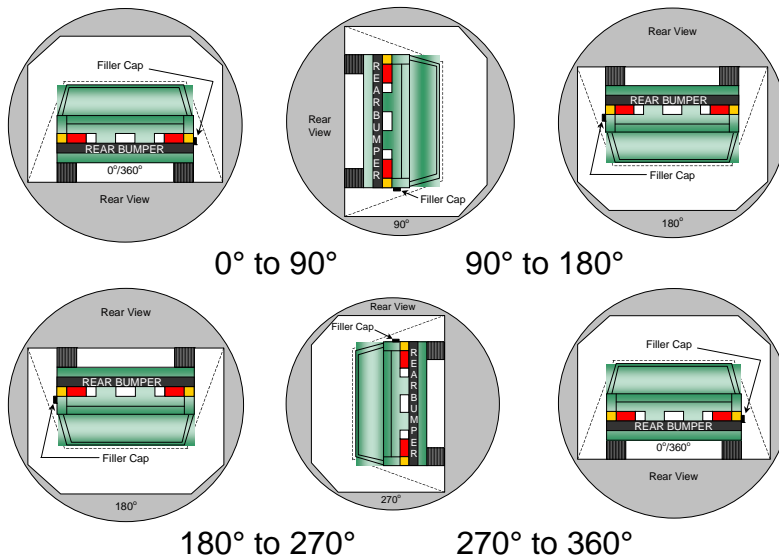
STATIC ROLLOVER TEST DATA

Test Vehicle: 2009 Mazda 3 NHTSA No.: C95404
 Test Program: FMVSS 301 Fuel System Integrity Test Date: 4/15/2009

STODDARD SOLVENT SPILLAGE MEASUREMENT

- A. From impact until vehicle motion ceases: 0 g
 (Maximum Allowable = 28 grams)
- B. For the 5 minute period after motion ceases: 0 g
 (Maximum Allowable = 28 grams)
- C. For the following 25 minutes: 0 g
 (Maximum Allowable = 28 grams/minute)
- D. Spillage: None

FMVSS 301 STATIC ROLLOVER DATA



1. The specified fixture rollover rate for each 90° of rotation is 60 to 180 seconds.

2. The position hold time at each position is 300 seconds (minimum).

3. Details of Stoddard Solvent spillage locations: **Not Applicable**

DATA SHEET NO. 5 (continued)
STATIC ROLLOVER TEST DATA

Test Vehicle: 2009 Mazda 3 NHTSA No.: C95404
 Test Program: FMVSS 301 Fuel System Integrity Test Date: 4/15/2009

STODDARD SOLVENT SPILLAGE MEASUREMENT
Hold Time = 5 minutes at all intervals

0° TO 90° Rotation Time (sec) = 116 sec

Test Phase	Spillage (g)	Spillage Details
First 5 minutes from onset of rotation	0	
Sixth minute from onset of rotation	0	
Seventh minute from onset of rotation	0	
Eight minute if required	N/A	

90° TO 180° Rotation Time (sec) = 118 sec

Test Phase	Spillage (g)	Spillage Details
First 5 minutes from onset of rotation	0	
Sixth minute from onset of rotation	0	
Seventh minute from onset of rotation	0	
Eight minute if required	N/A	

180° TO 270° Rotation Time (sec) = 111 sec

Test Phase	Spillage (g)	Spillage Details
First 5 minutes from onset of rotation	0	
Sixth minute from onset of rotation	0	
Seventh minute from onset of rotation	0	
Eight minute if required	N/A	

270° TO 360° Rotation Time (sec) = 118 sec

Test Phase	Spillage (g)	Spillage Details
First 5 minutes from onset of rotation	0	
Sixth minute from onset of rotation	0	
Seventh minute from onset of rotation	0	
Eight minute if required	N/A	

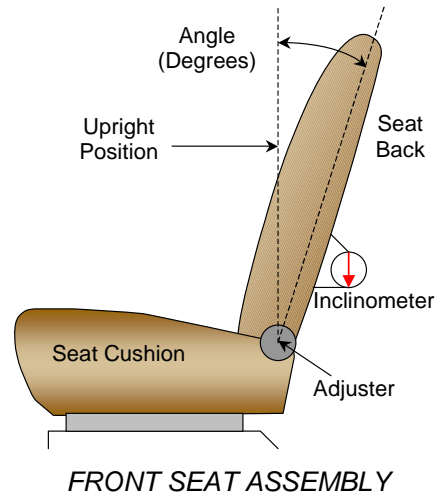
FORM 1
TEST VEHICLE INFORMATION

Test Vehicle: 2009 Mazda 3
Test Program: FMVSS 301 Fuel System Integrity

NHTSA No.: C95404
Test Date: 4/15/2009

NORMAL DESIGN RIDING POSITION

With the seat in the mid fore-aft seat track position the angle of the driver's seat back when it is in the nominal riding position is set at 16.7 degrees (headrest pole angle), front passenger is set at 14.5 degrees (headrest pole angle).



Driver Seat Back Angle	16.7° (headrest pole angle)
Passenger Seat Back Angle	14.6° (headrest pole angle)

SEAT FORE/AFT POSITIONING

	Total Fore/Aft Travel	Placed in Position #
Driver Seat	26 detents	10 th detent, 1 st as 0
Passenger Seat	26 detents	13 th detent, 1 st as 0

D-RING ADJUSTMENT

The driver and passenger D-rings were full up.

STEERING COLUMN ADJUSTMENT

The steering column was placed in the mid position.

APPENDIX A
PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

Page No.

Photo No. 1.	Vehicle's Certification Label	A-1
Photo No. 2.	Vehicle's Tire Placard	A-2
Photo No. 3.	Pre-Test Front View of Vehicle	A-3
Photo No. 4.	Post-Test Front View of Vehicle	A-4
Photo No. 5.	Pre-Test Left Side View of Vehicle	A-5
Photo No. 6.	Post-Test Left Side View of Vehicle	A-6
Photo No. 7.	Pre-Test Left Rear Close-up View of Vehicle	A-7
Photo No. 8.	Post-Test Left Rear Close-up View of Vehicle	A-8
Photo No. 9.	Pre-Test Right Side View of Vehicle	A-9
Photo No. 10.	Post-Test Right Side View of Vehicle	A-10
Photo No. 11.	Pre-Test Right Rear Close-up View of Vehicle	A-11
Photo No. 12.	Post-Test Right Rear Close-up View of Vehicle	A-12
Photo No. 13.	Pre-Test Rear View of Vehicle	A-13
Photo No. 14.	Post-Test Rear View of Vehicle	A-14
Photo No. 15.	Pre-Test $\frac{3}{4}$ Frontal View From Right Side of Vehicle	A-15
Photo No. 16.	Post-Test $\frac{3}{4}$ Frontal View From Right Side of Vehicle	A-16
Photo No. 17.	Pre-Test $\frac{3}{4}$ Rear View From Right Side of Vehicle	A-17
Photo No. 18.	Post-Test $\frac{3}{4}$ Rear View From Right Side of Vehicle	A-18
Photo No. 19.	Pre-Test $\frac{3}{4}$ Rear View From Left Side of Vehicle	A-19
Photo No. 20.	Post-Test $\frac{3}{4}$ Rear View From Left Side of Vehicle	A-20
Photo No. 21.	Pre-Test Impact Point	A-21
Photo No. 22.	Post-Test Impact Point	A-22
Photo No. 23.	Pre-Test Underbody View 1	A-23
Photo No. 24.	Post-Test Underbody View 1	A-24
Photo No. 25.	Pre-Test Underbody View 2	A-25
Photo No. 26.	Post-Test Underbody View 2	A-26
Photo No. 27.	Pre-Test Underbody View 3	A-27

Page No.

Photo No. 28.	Post-Test Underbody View 3	A-28
Photo No. 29.	Pre-Test Underbody View 4	A-29
Photo No. 30.	Post-Test Underbody View 4	A-30
Photo No. 31.	Pre-Test Front View of MDB	A-31
Photo No. 32.	Post-Test Front View of MDB	A-32
Photo No. 33.	Pre-Test $\frac{3}{4}$ Right Side View of MDB	A-33
Photo No. 34.	Post-Test $\frac{3}{4}$ Right Side View of MDB	A-34
Photo No. 35.	Pre-Test $\frac{3}{4}$ Left Side View of MDB	A-35
Photo No. 36.	Post-Test $\frac{3}{4}$ Left Side View of MDB	A-36
Photo No. 37.	Pre-Test Top View of MDB	A-37
Photo No. 38.	Post-Test Top View of MDB	A-38
Photo No. 39.	Static Rollover at 90 Degrees	A-39
Photo No. 40.	Static Rollover at 180 Degrees	A-40
Photo No. 41.	Static Rollover at 270 Degrees	A-41
Photo No. 42.	Static Rollover at 360 Degrees	A-42

MFD. BY MAZDA MOTOR CORPORATION

DATE	GVWR/PNBV	GAWR/PNBE FRT	GAWR/PNBE RR
10/08	3821 LB	2068 LB	1753 LB
	1733 KG	938 KG	795 KG

THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY
/ BUMPER, AND THEFT PREVENTION
STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE.

JM1BK32F991241522 TYPE: PASSENGER



BODY COLOR CODE: 32V

MADE IN JAPAN



TIRE AND LOADING INFORMATION

SEATING CAPACITY : TOTAL 5 : FRONT 2 : REAR 3

The combined weight of occupants and cargo should never exceed 385kg or 850lbs.

TIRE	SIZE	COLD TIRE PRESSURE
FRONT	P205/50R17	220KPA, 32PSI
REAR	P205/50R17	220KPA, 32PSI
SPARE	T115/70D15	420KPA, 60PSI

**SEE OWNER'S
MANUAL FOR
ADDITIONAL
INFORMATION**

(BAN9)

Vehicle's Tire Placard



Pre-Test Front View of Vehicle



Post-Test Front View of Vehicle



Pre-Test Left Side View of Vehicle



Post-Test Left Side View of Vehicle

A-7.



Pre-Test Left Rear Close-up View of Vehicle

A-8.



Post-Test Left Rear Close-up View of Vehicle



Pre-Test Right Side View of Vehicle



Post-Test Right Side View of Vehicle

A-11.



Pre-Test Right Rear Close-up View of Vehicle



Post-Test Right Rear Close-up View of Vehicle

A-13.



Pre-Test Rear View of Vehicle

A-14.



Post-Test Rear View of Vehicle



Pre-Test ¾ Frontal View From Right Side of Vehicle



Post-Test $\frac{3}{4}$ Frontal View From Right Side of Vehicle



Pre-Test ¾ Rear View From Right Side of Vehicle



Post-Test $\frac{3}{4}$ Rear View From Right Side of Vehicle

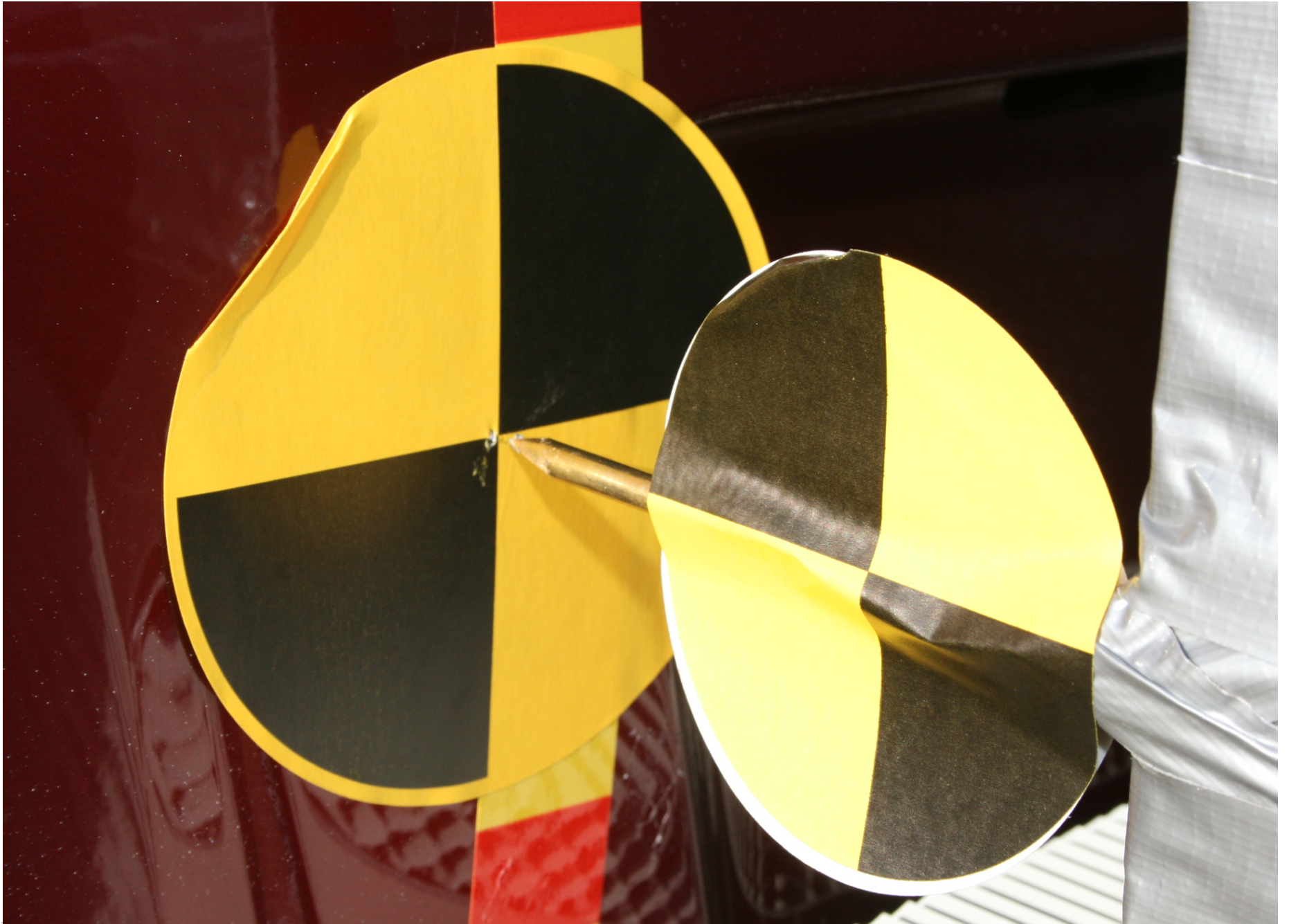


Pre-Test $\frac{3}{4}$ Rear View From Left Side of Vehicle



Post-Test ¾ Rear View From Left Side of Vehicle

A-21.

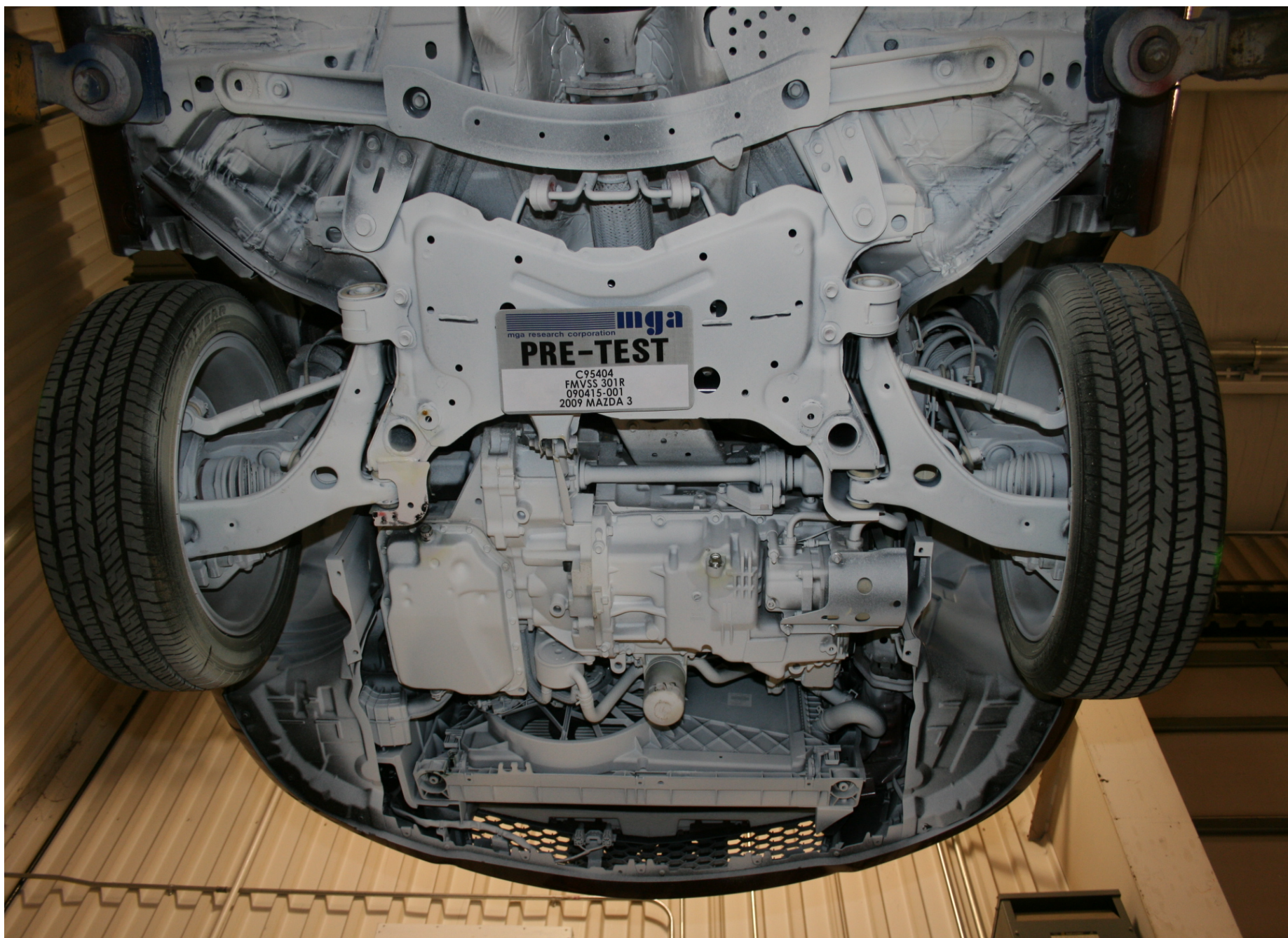


Pre-Test Impact Point

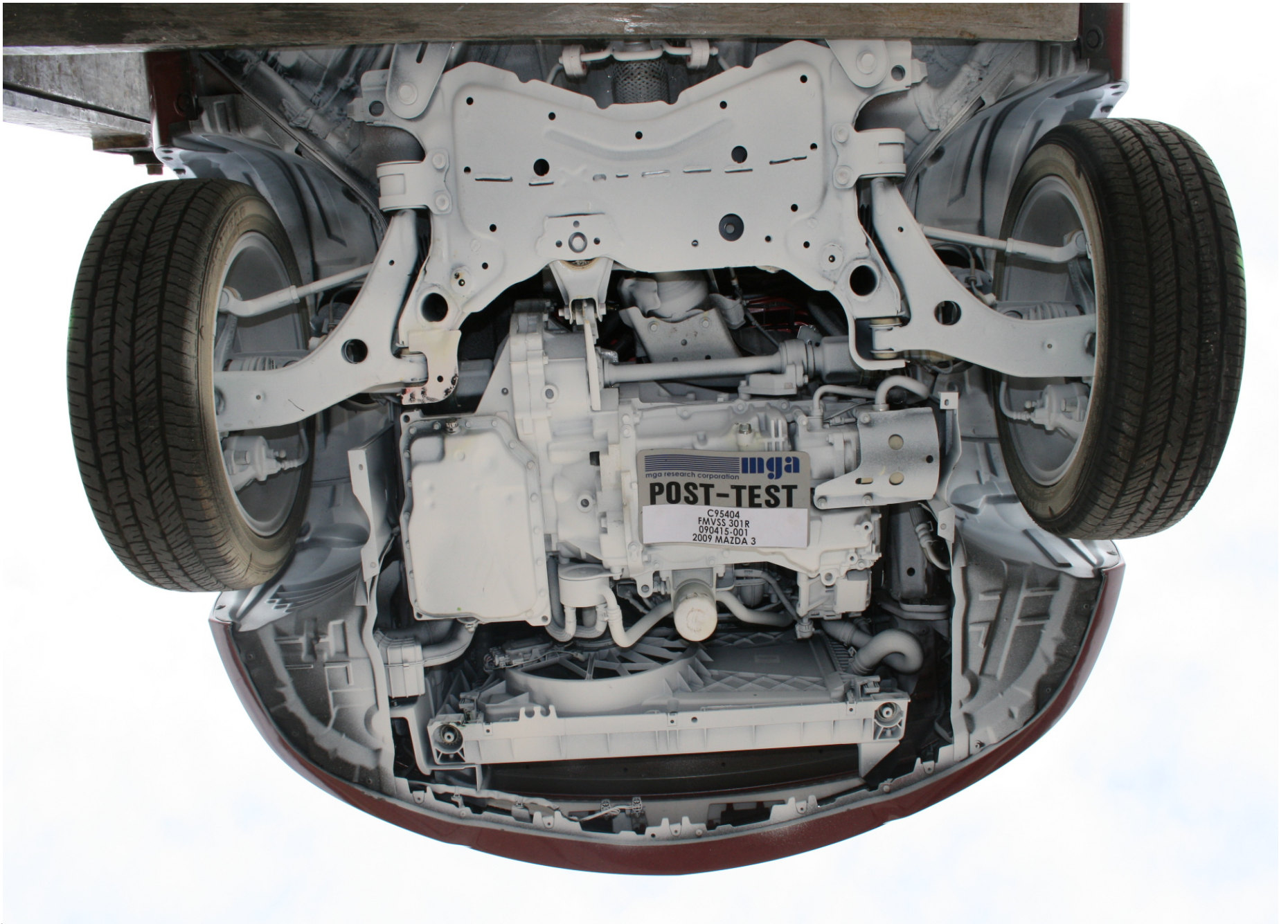
A-22.



Post-Test Impact Point

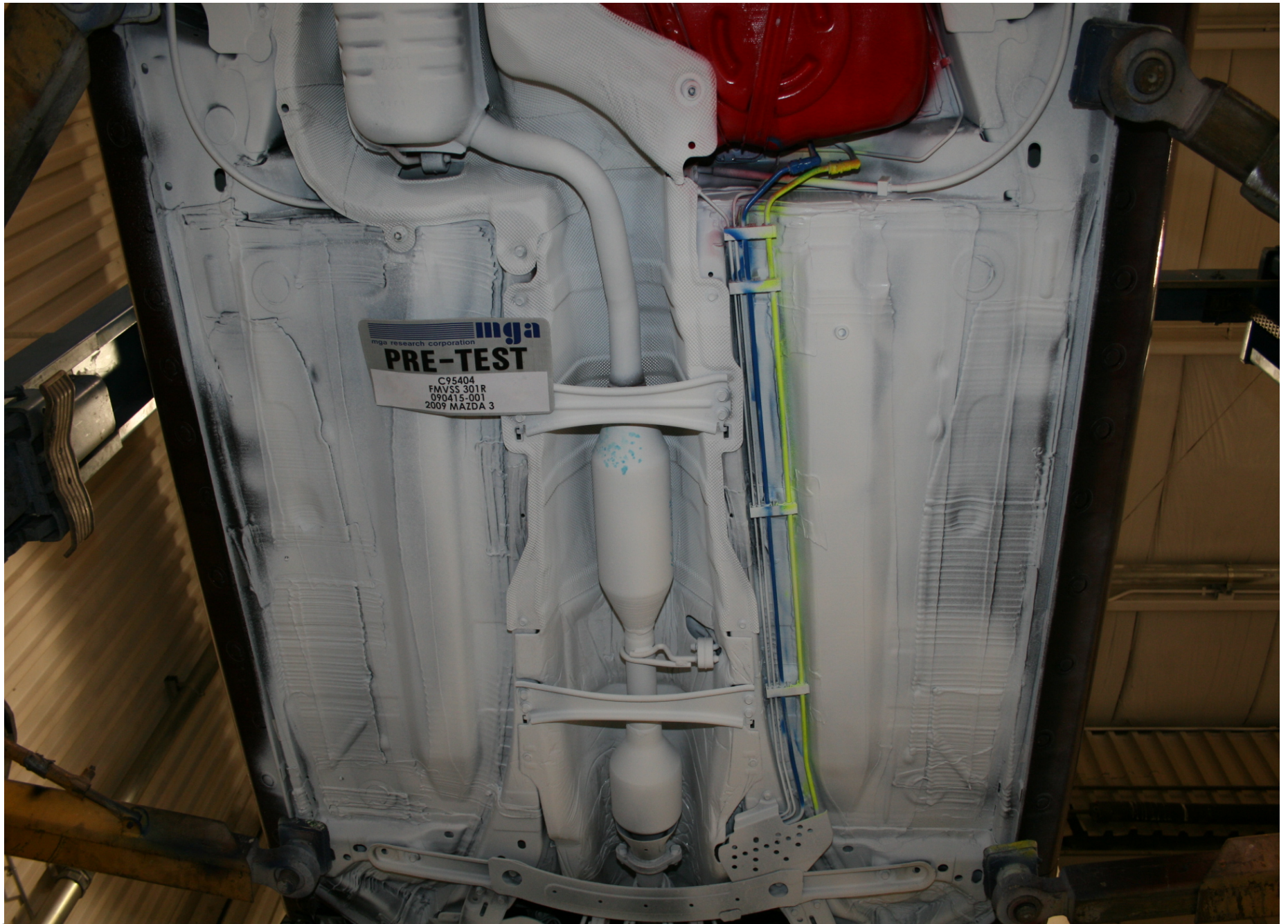


Pre-Test Underbody View 1



A-24.

Post-Test Underbody View 1

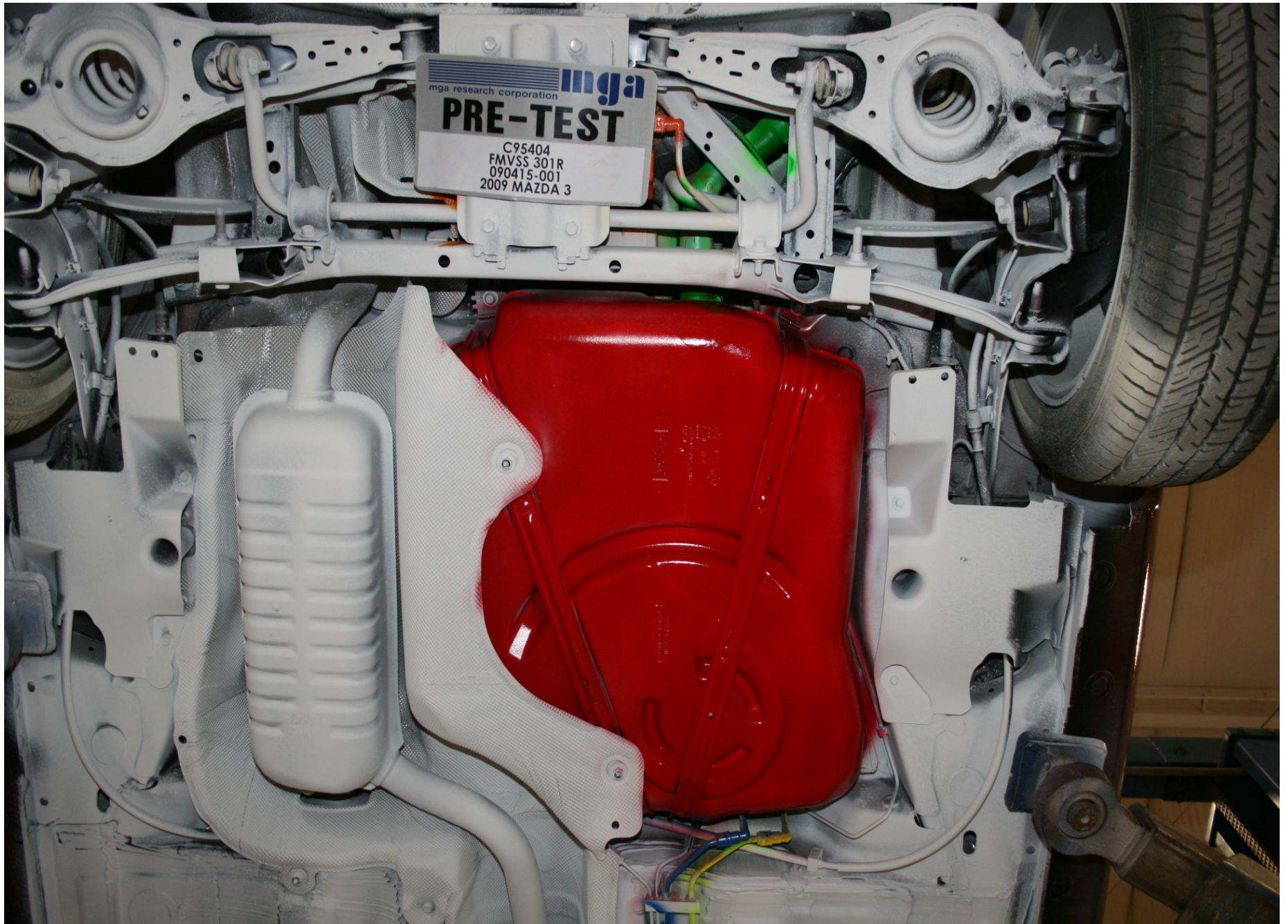


Pre-Test Underbody View 2

A-26.

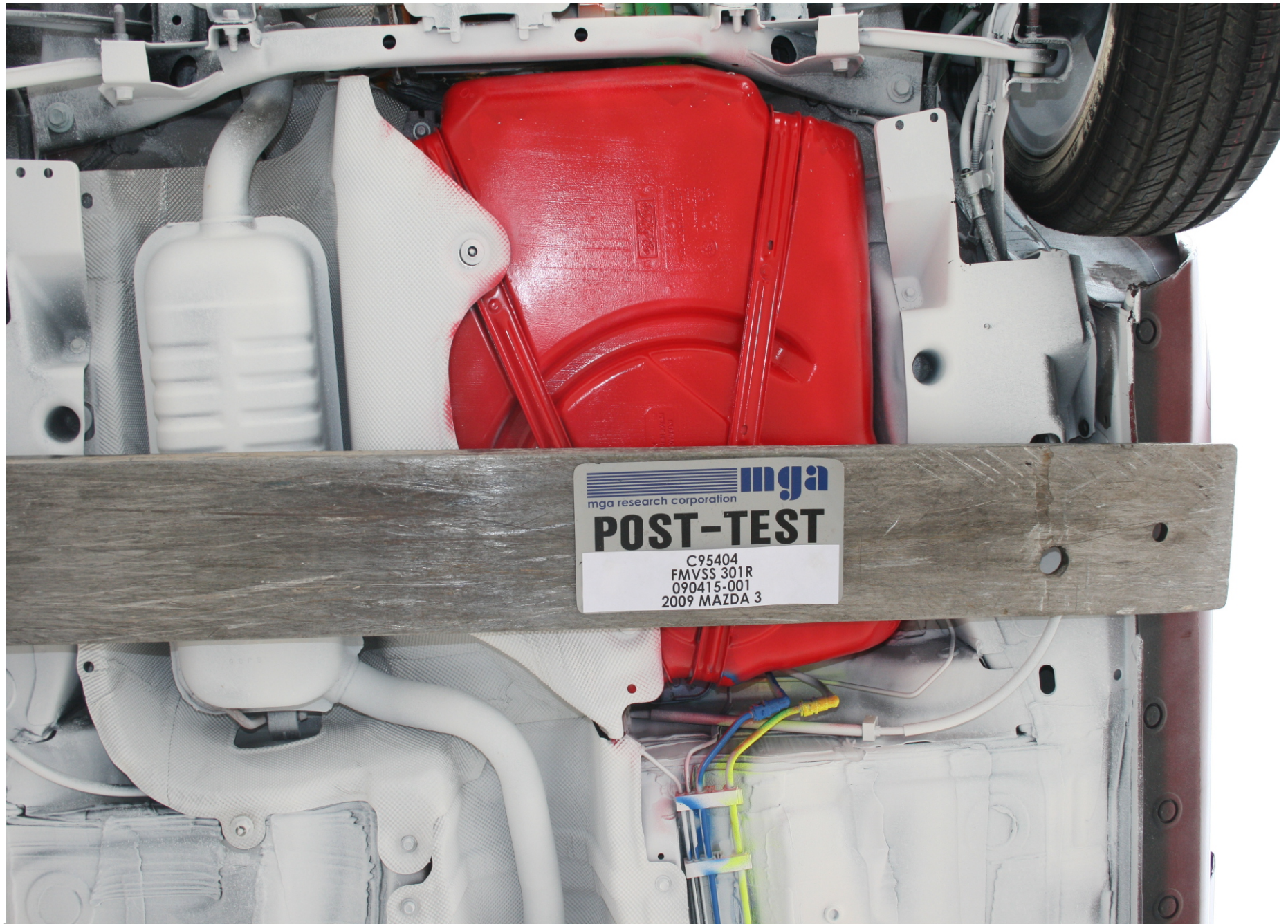


Post-Test Underbody View 2

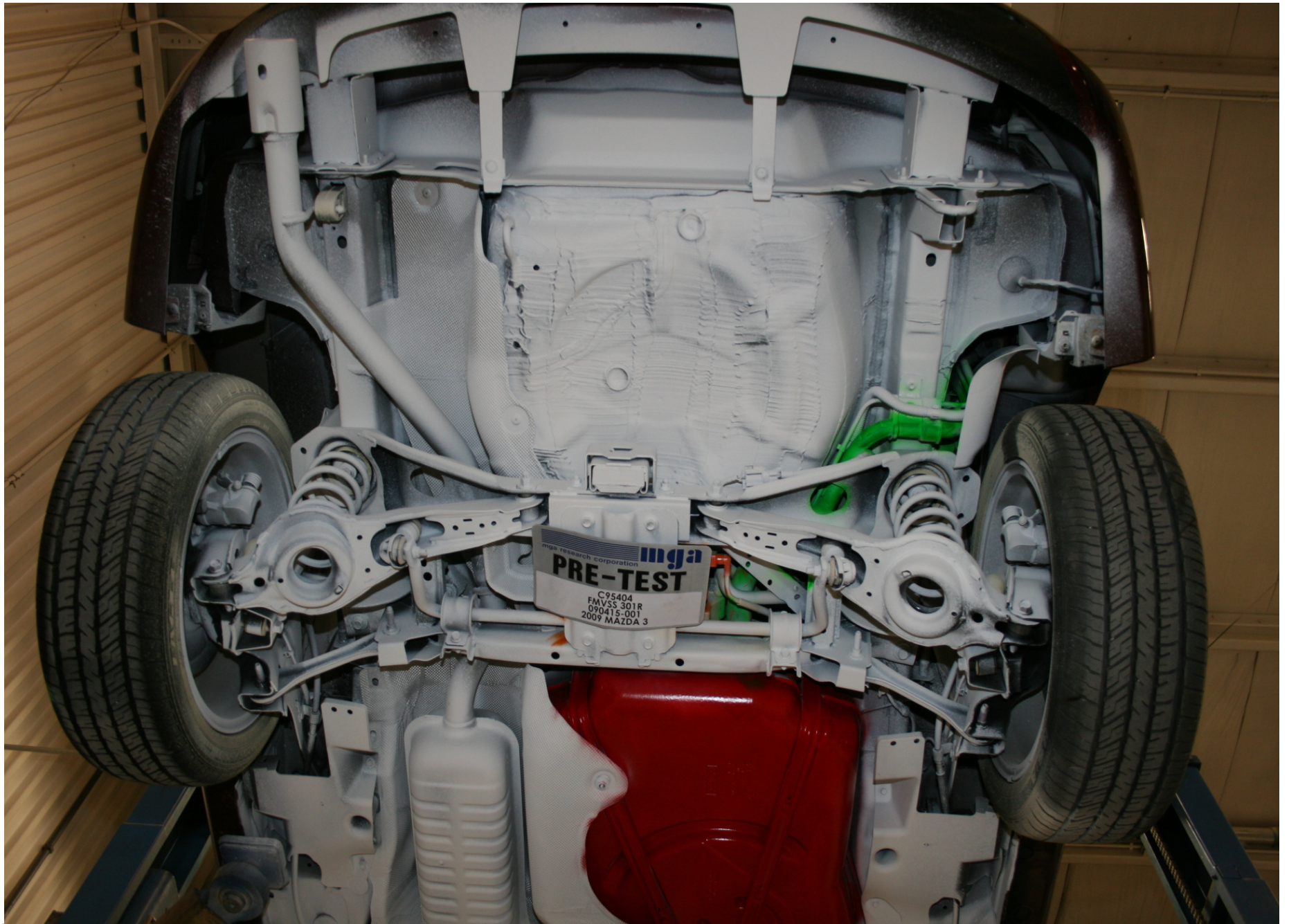


Pre-Test Underbody View 3

A-28.

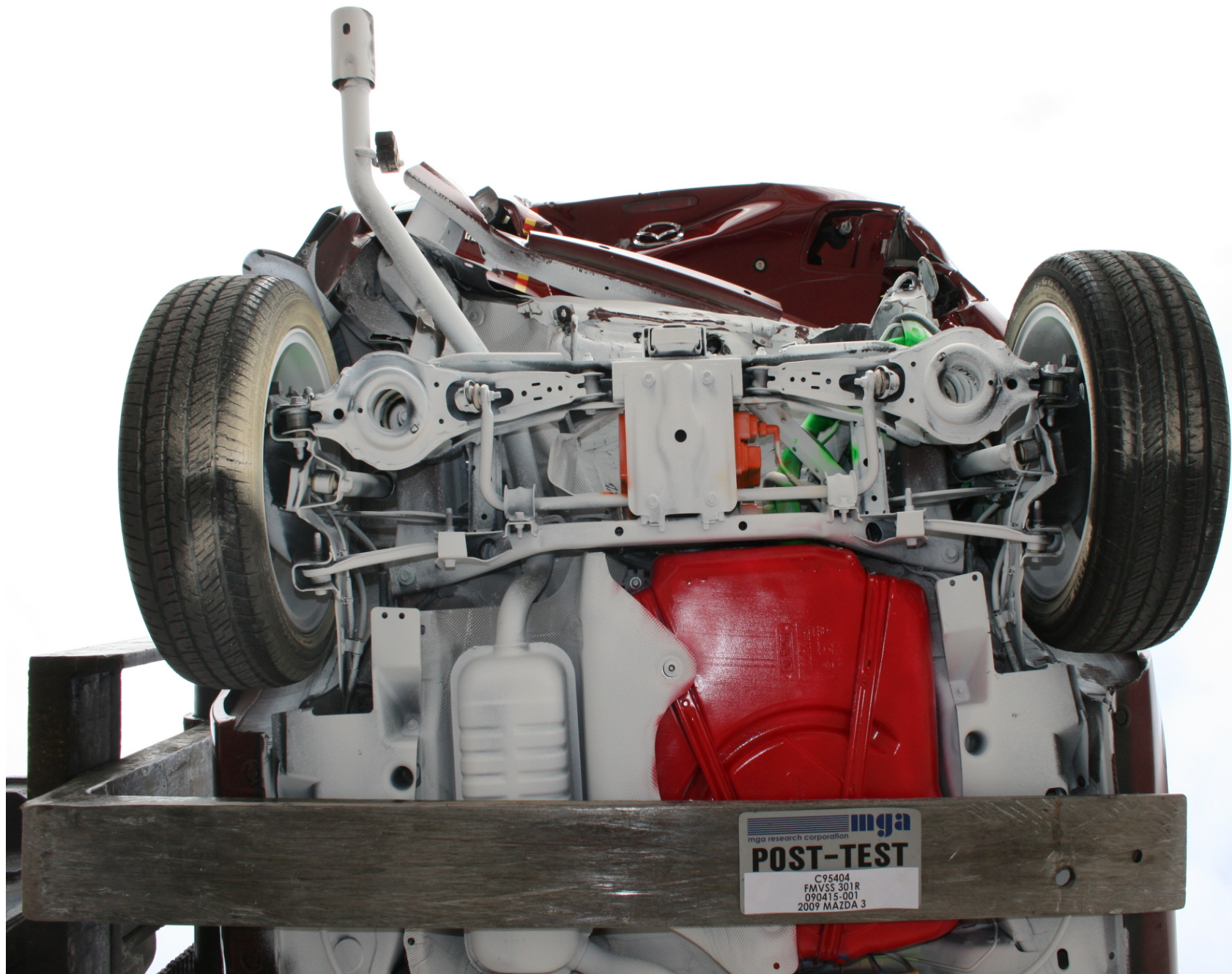


Post-Test Underbody View 3



Pre-Test Underbody View 4

A-30.



Post-Test Underbody View 4



Pre-Test Front View of MDB



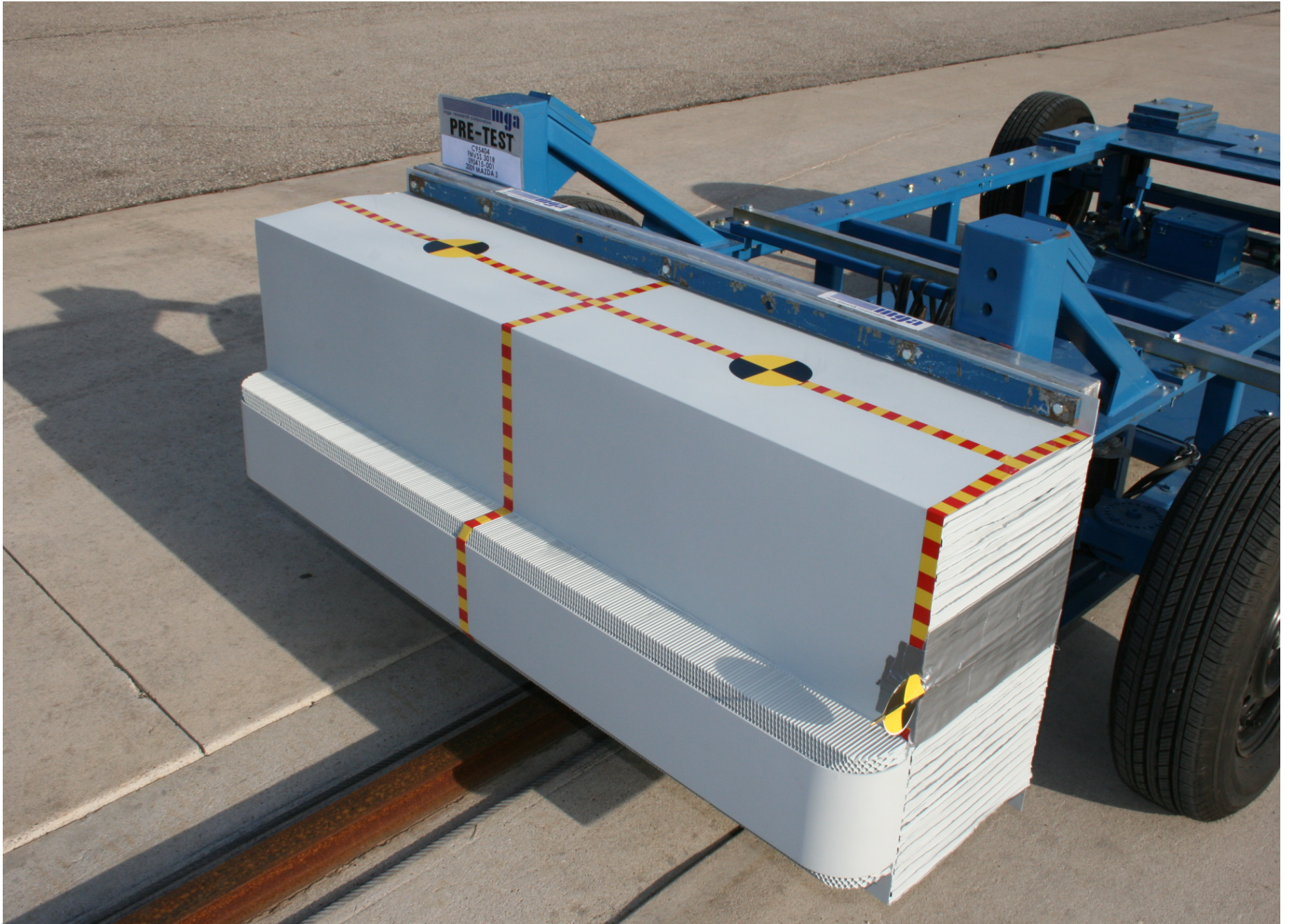
Post-Test Front View of MDB



Pre-Test $\frac{3}{4}$ Right Side View of MDB



Post-Test ¾ Right Side View of MDB

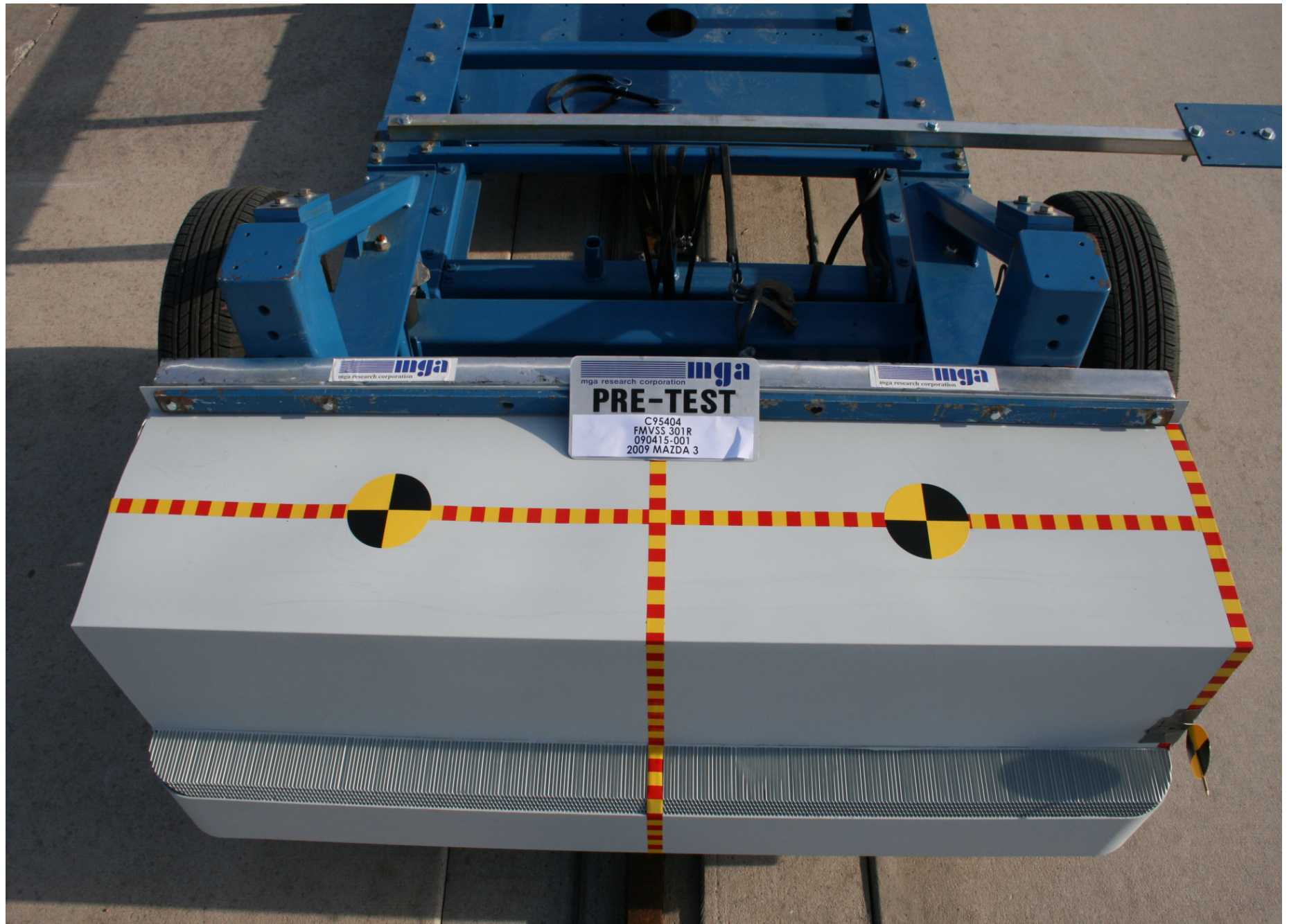


Pre-Test 3/4 Left Side View of MDB



Post-Test ¾ Left Side View of MDB

A-37.



Pre-Test Top View of MDB



Post-Test Top View of MDB

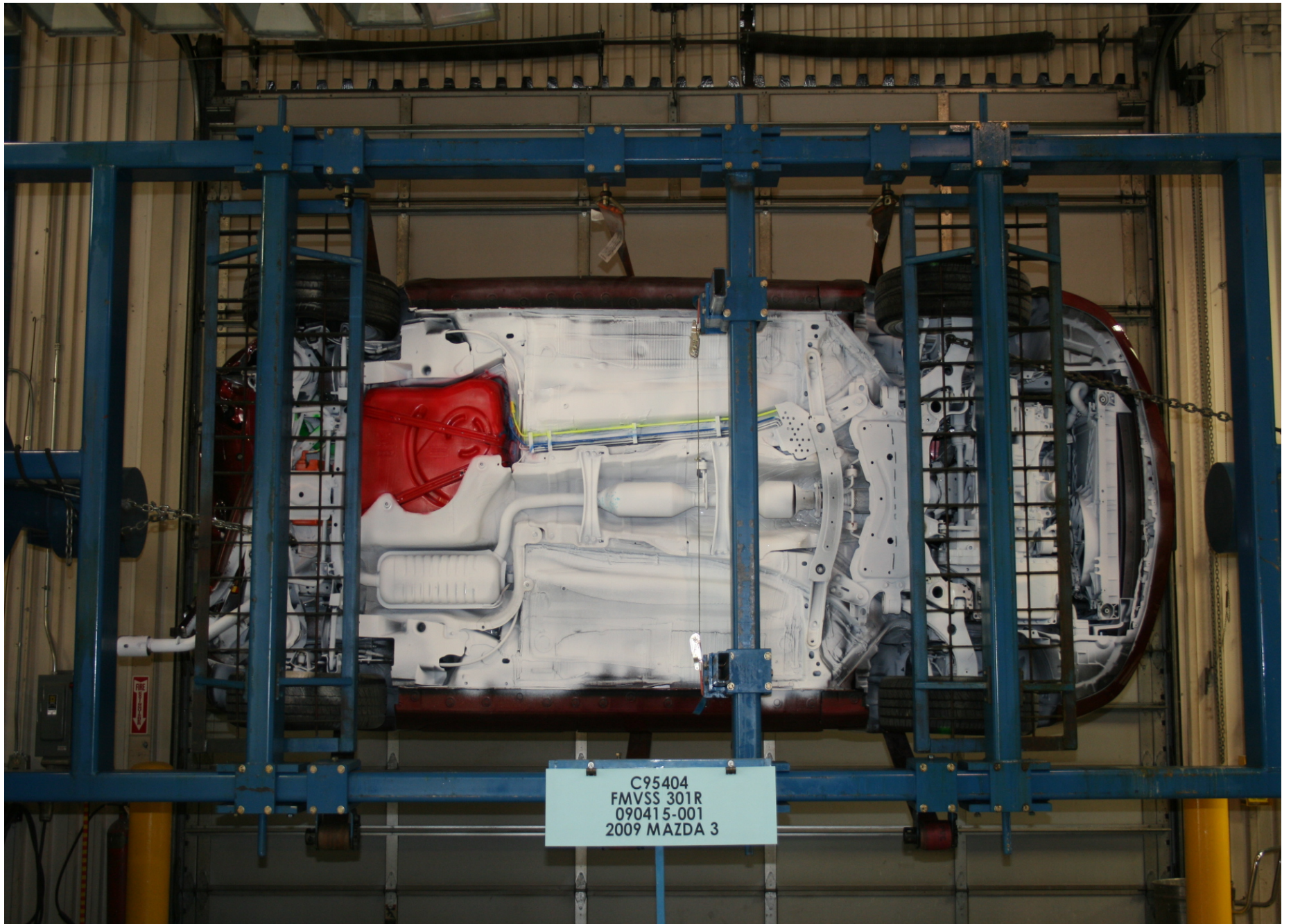


Static Rollover at 90 Degrees



Static Rollover at 180 Degrees

A-41.



Static Rollover at 270 Degrees



Static Rollover at 360 Degrees